



A user-guide to the FISHSELECT software tool

Herrmann, Bent

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A USER-GUIDE
TO
THE
FISHSELECT SOFTWARE TOOL

Bent Herrmann 2008

Introduction

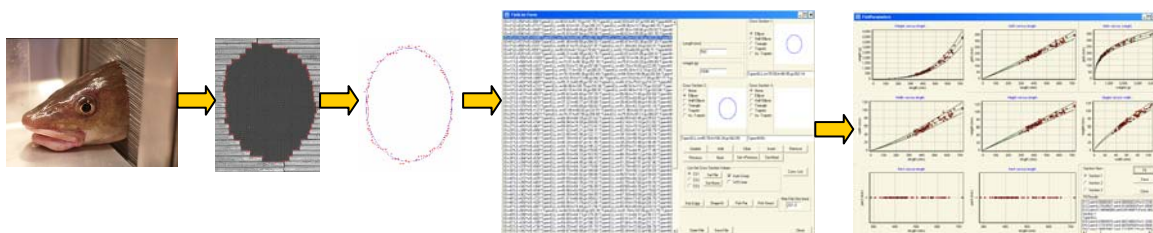
This manual gives a short overview of the facilities implemented in the FISHSELECT software tool. It shows the different windows in the tool and how to navigate between them. It also briefly describes what the different windows can be used to do. The software tool is implemented using the development tool Delphi from Borland Software Corporation. FISHSELECT software tool can be run on a powerful personal computer having a Microsoft Windows operating system.

Briefly, FISHSELECT is a methodology to assess the morphological conditions for different species of fish and crustaceans relevant in the process of mesh (and grid) penetration in towed fishing gears. It is based on a combination of laboratory experiments with freshly caught individuals, data collection, data analysis and computer simulations. The FISHSELECT software tool supports all these tasks.

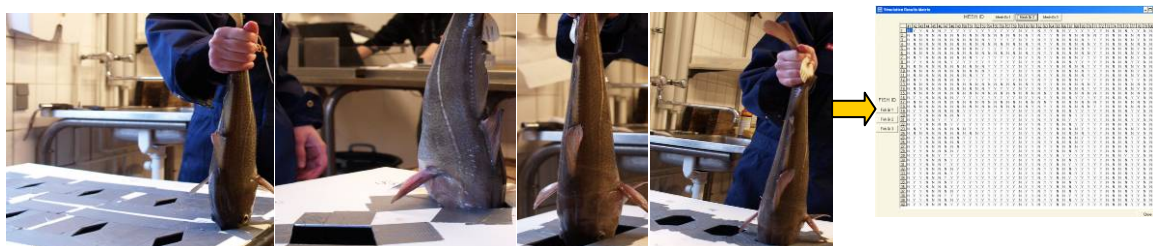
The four main elements (a to d) in the FISHSELECT methodology are described below.

a. Laboratory experiments and data collection.

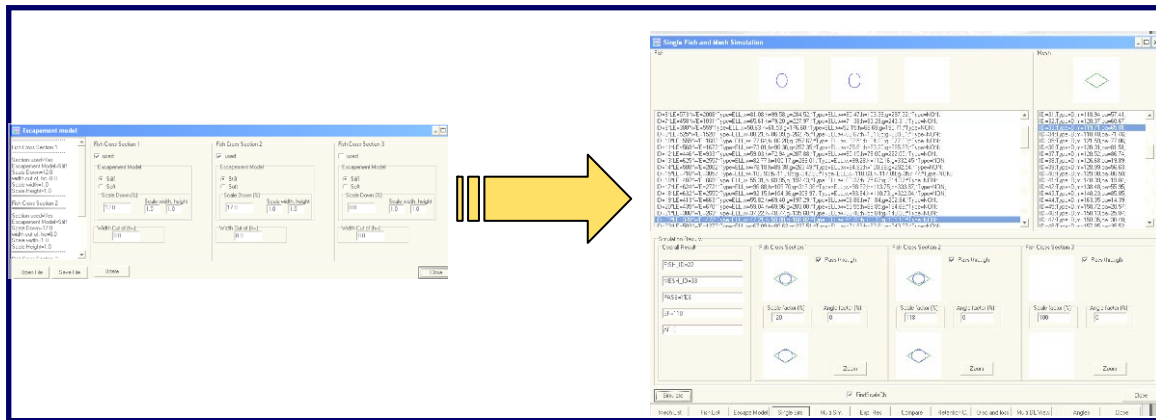
Length and weight are recorded for each individual. Cross sections that potentially could influence the ability of the species to penetrate meshes or grids are recorded with regard to shape and size. This is done by use of a specially designed mechanical tool (MorphoMeter), scanning with a flatbed scanner and digital image analysis. Based on different geometrical shapes, the cross sections are automatically described by a few parameters. The values of the parameters are linked to the length of the individuals by applying regression analysis. All data are recorded and analysed in the FISHSELECT software tool.



Template plates with holes imitating a large number of different meshes are used. For each individual it is tested and recorded whether or not it can pass through a given mesh. Fish are always oriented head first and pulled by the force of gravity alone.



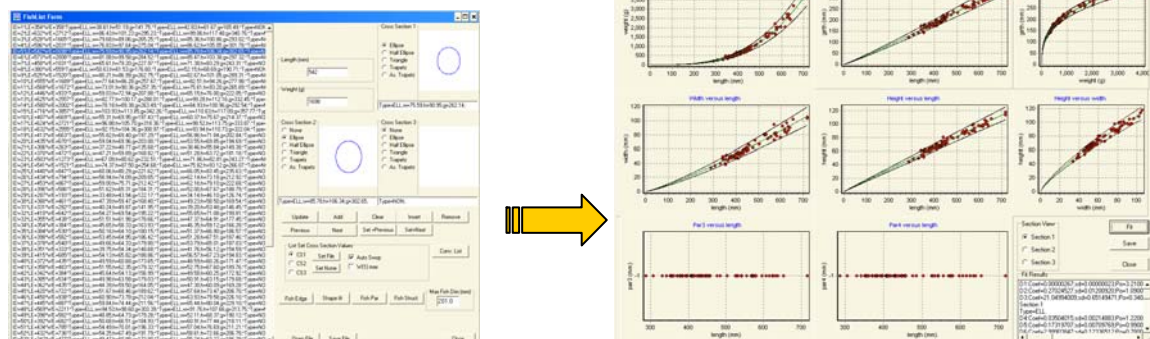
- b. Simulation of laboratory experiments on mesh penetration.
- By use of built-in facilities in the simulation tool, the experimental morphological descriptions of the cross sections and information about the mesh holes are combined and this feature enables a simulation of the experimental penetration experiments. The model facilities allow inclusion and exclusion of different cross sections as well as different ways to account for compression or distortion of the cross sections during the penetration attempts. Subsequently, the tool is used to compare the experimental results with the corresponding simulated results. The same set of fish is run through a series of simulations using different combinations of cross sections and different compressions/distortions. This procedure enables the user to identify the cross sections most important for mesh penetration of the given species. Furthermore, this procedure improves the understanding on how and to what extent these cross sections are compressed or distorted during penetration.



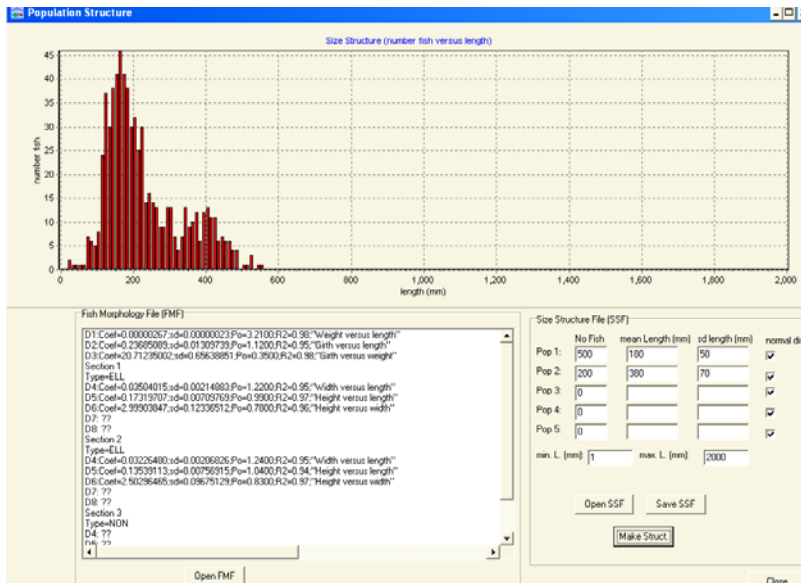
In this way, it is established which cross section information to use and how to use these to simulate penetration through any mesh for the species being studied. These informations are compiled in what is called the penetration model.

- c. Establishment of morphological relationships
- There is a built-in functionality to describe the relationship between fish length and the parameters describing the cross sections and fish length. The output contains the fit statistics and variance of the parameter values.

Morphological relationships

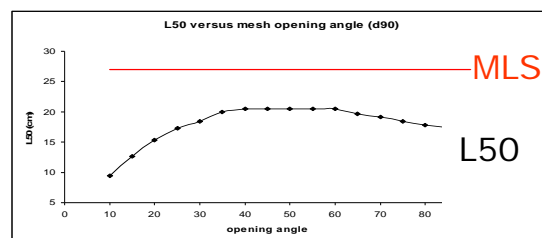
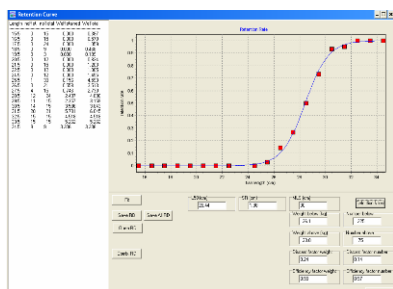


This information can then be used to construct a virtual population of the species having similar morphological characteristics with respect to mesh penetration ability as the fish tested experimentally. The between-individuals-variation in the relationship between length and the parameter values describing the cross sections shapes and sizes will also be included in the virtual population.



d. Estimation of basic selectivity of netting panels

Data for the virtual population of fish and data for mesh panels of interest are combined to make a new series of simulations with the established penetration model. The built-in functionality enables the user to estimate the basic selective properties (selection curves) for the selected netting panels for the species being studied. For a specific panel, it also enables a prediction of whether or not there is a reasonable balance between the selective properties of the netting panel and the minimum landing size (MLS) for the species.



Thus if information on the large scale population structure of a species is available for a particular fishery, the built-in functionality gives a first indicative prediction of the consequences on discard / loss of marketable fish, of using the netting panel in combination with the chosen MLS.

Table 1 contains a list of the different windows in FISHSELECT tool and on which page in this manual they are shown and described. To ensure the functionality of the program, the order of filling in values, should follow the order of the list below.

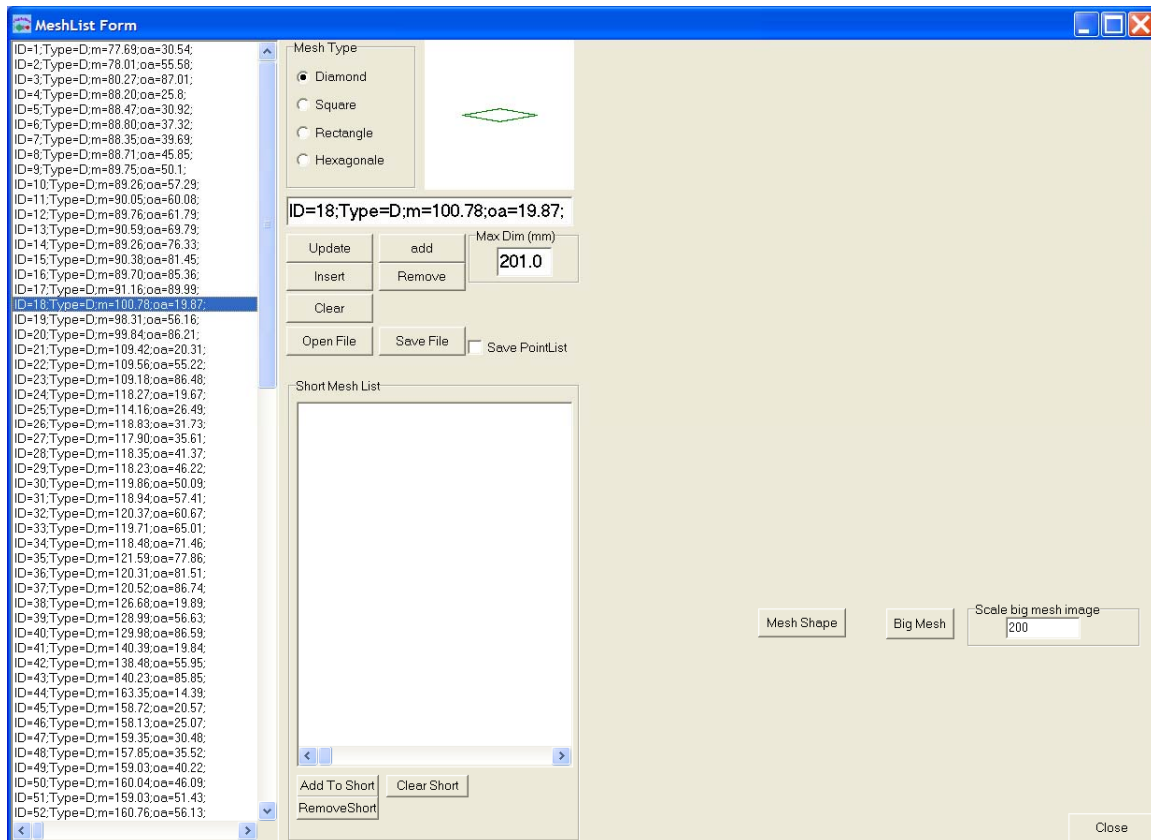
Window	Page
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Main Window.



When starting FISHSELECT from Microsoft Windows the **Main Window** shows up. The user controls what goes on in FISHSELECT by using the mouse to activate the buttons in the lower part of the window.

Mesh List window



Access: from **Main Windows** by clicking on the **Mesh List** button.

Use the **Mesh List Window** to define the different mesh shapes and sizes used in the experiment in the laboratory and/or in the simulations.

A special syntax language and an associated interpreter for the syntax has been developed and implemented in the software tool. The list is saved in a text-file format with the extension MLF (Mesh List File) and data are thus accessible outside the program.

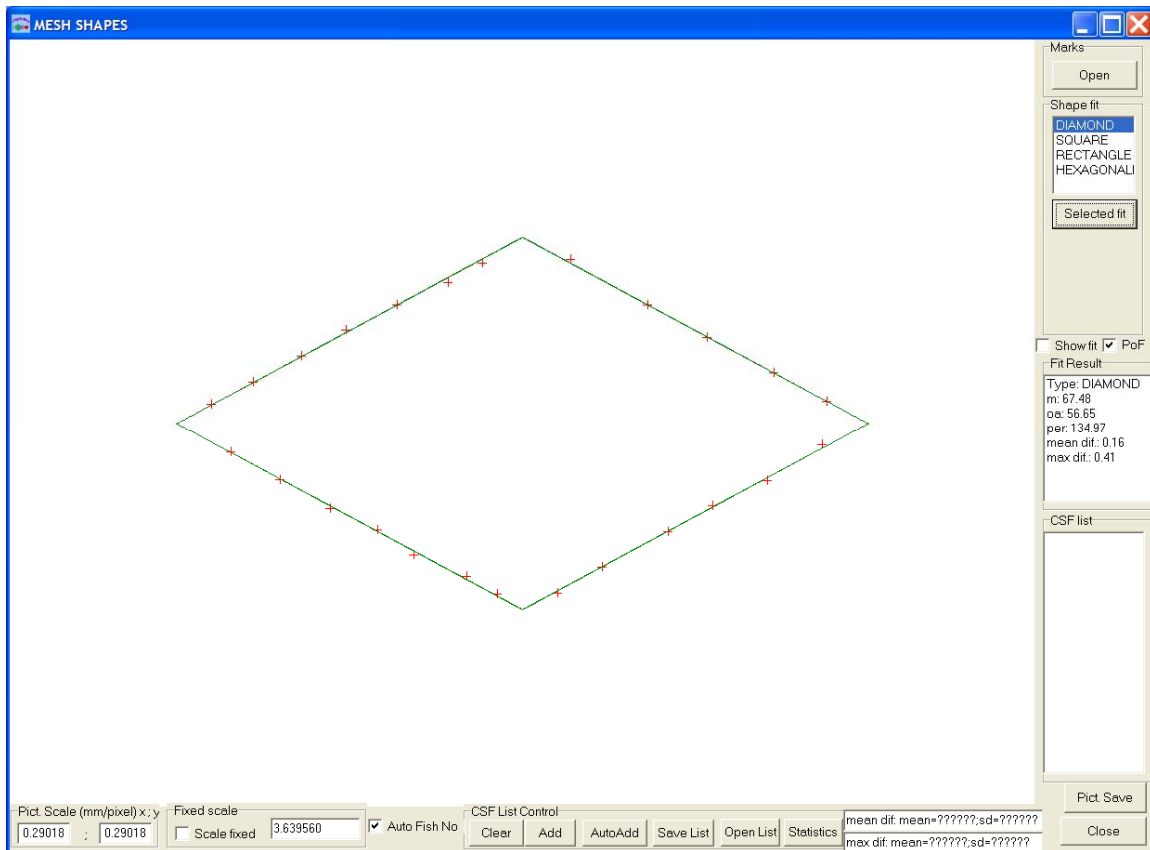
Four mesh types are implemented: D (Diamond), S (Square), R (Rectangle), H (Hexagonal). Mesh type is selected by setting the appropriate radio button in the **Mesh Type Panel**. Use the buttons **Update**, **Add**, **Insert**, **Remove**, **Clear** to define the mesh list. Use button **Open File** to open an existing Mesh List File. Use button **Save File** to save the current mesh list to a MLF file.

The **Short Mesh List Panel** makes it possible to select a subset of meshes from the current mesh list. It is possible to run simulations in the **Multiple Simulation Window** for that subset only instead of for the full list. Use button **Add To Short** to add the marked mesh in the full mesh list to the short list. Use button **Remove Short** to remove the marked mesh in the short mesh list from the short list. Use button **Clear Short** to clear the short list.

Use button **Mesh Shape** to access the **Mesh Shape Window**.

The button **Big Mesh** automatically saves a JPG-picture of the marked mesh in the mesh list.

Mesh Shape Window



Access: from **Mesh List Window** by activating button **Mesh Shape**.

If measured shape data for a mesh have been saved as a set of coordinate points (x,y) in a file complying with the MKS (MarKS file) format like that generated in the **Fish Edge Window**, the file can be viewed as x,y points (the red crosses) in this window. In the **Shape fit Panel** select the mesh type to try to fit to the coordinate points. The main result from the fit is shown in the **Fit Result Panel**. In the example above a diamond shape is fitted to the points. Mesh size m is found to be 67.48 mm and the opening angle oa to be 56.65 °. The mean difference between the points and the fitted diamond shape is 0.16 mm while the maximal difference is found to be 0.41 mm. The fitting procedure is based on a least square technique.

When opening a MKS file, the screen view is automatically scaled to optimum size. If one wants to compare MKS files of meshes of different sizes this may be impractical. The automatic scaling can be disabled by checking the checkbox **Scale fixed**.

Fish List Window

The FishList Form window displays a list of fish definitions on the left and cross-section settings on the right. The list includes parameters such as ID, Length (mm), Weight (g), and cross-section type (e.g., Ellipse, Half Ellipse, Triangle, Trapez, As. Trapez). The right panel shows three cross-sections (Cross Section 1, 2, and 3) with their respective shapes and dimensions. The bottom of the window contains buttons for Update, Add, Clear, Insert, Remove, Previous, Next, Set Previous, Set Next, and a Max Fish Dim (mm) field set to 201.0.

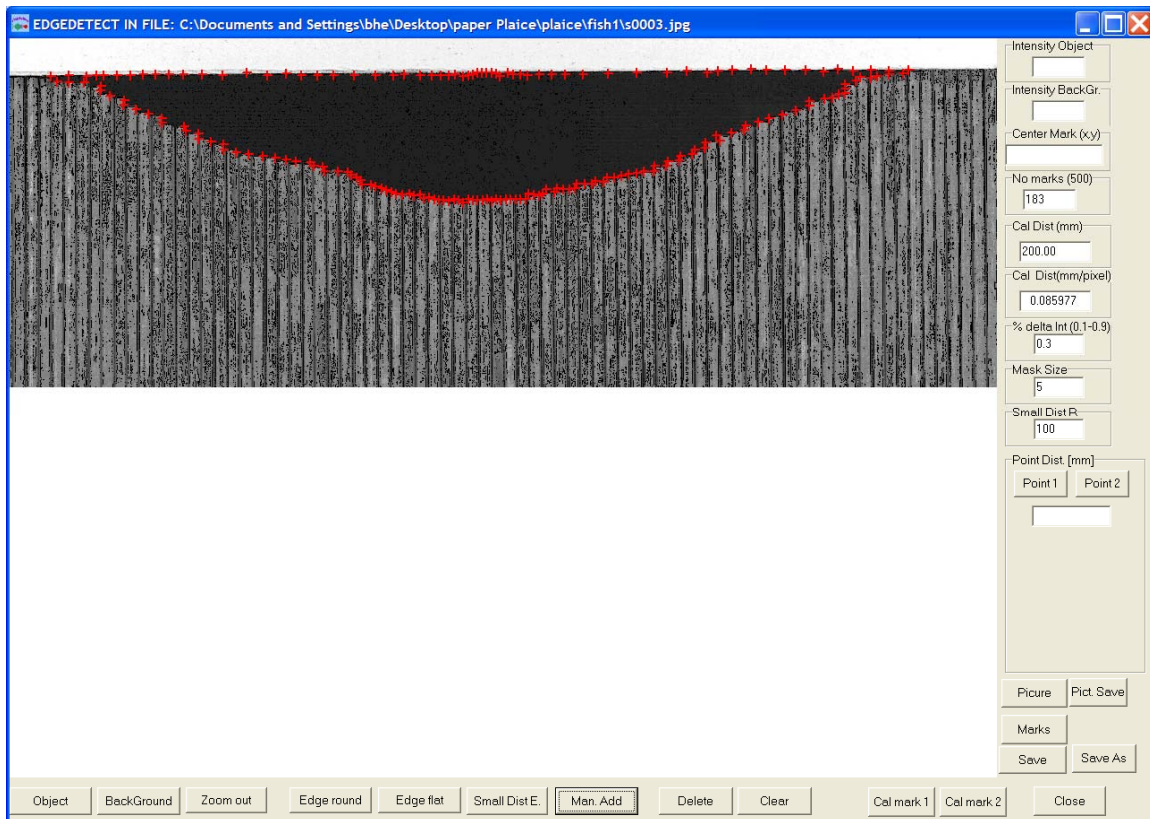
Access: from **Main Window** by activating button **Fish List**.

Use the **Fish List Window** to organize a list of different individual fish definitions used in the experiment in the laboratory and/or in the simulations.

A special syntax language and an associated interpreter for the syntax has been developed and implemented in the software tool. The list is saved in a text-file format with the extension FLF (Fish List File) which makes data accessible outside the program. Use the buttons **Update**, **Add**, **Insert**, **Remove**, **Clear** to define the mesh list. Use button **Open File** to open an existing Fish List File. Use button **Save File** to save the current fish list to a FLF file.

Parameters defining shapes and sizes of up to three different cross sections (CS1, CS2, CS3) can be included for each fish. The parameters of the cross sections are obtained in the Fish Shape Fit Window.

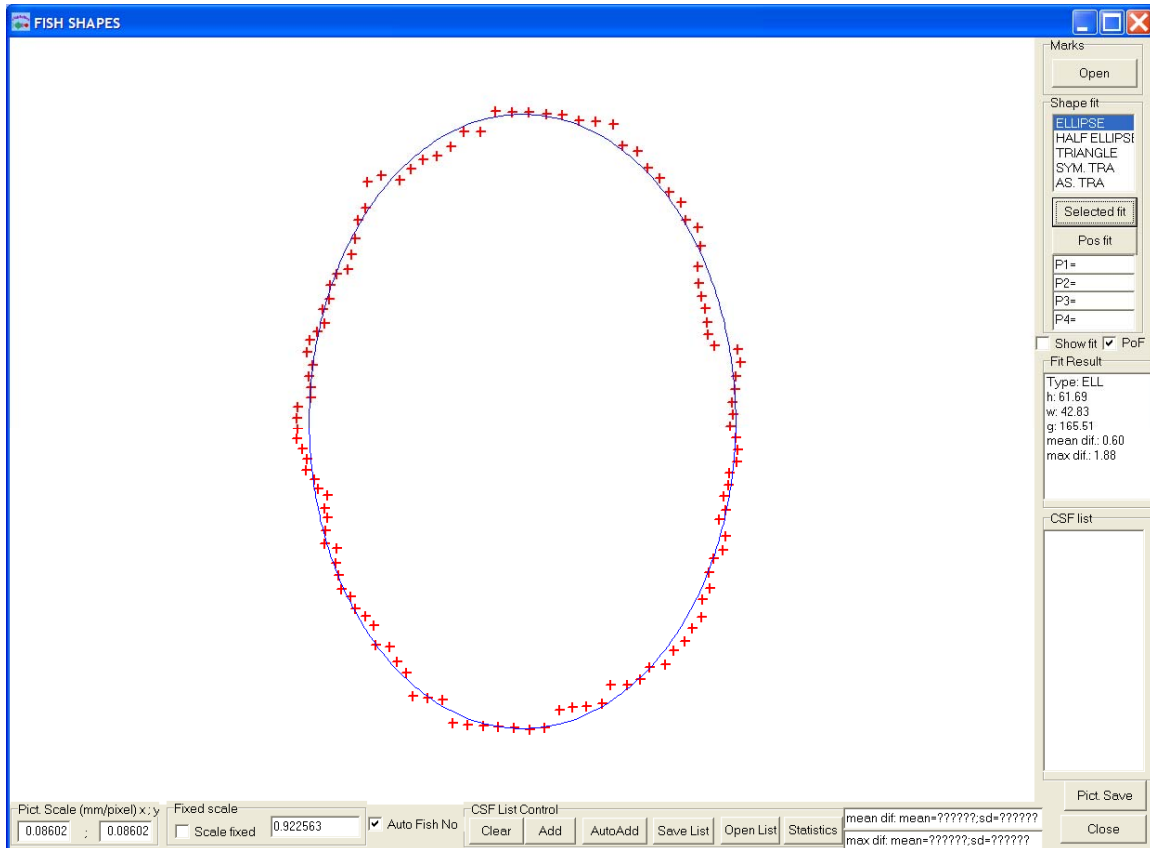
Fish Edge Window



Access: from **Fish List Window** by activating button **Fish Edge**.

Use the **Fish Edge Window** to extract the Cross Section outline contour from a scanned image of the mechanical MorphoMeter by applying the built-in image analysis functions (buttons **Edge round**, **Edge flat**, **Small Dist E.**, **Man. Add**, **Delete**, **Clear**). Click the button **Object** and then click the mouse to mark the centre of the object (centre of cross section). Use button **BackGround** in the same way to define the background colour intensity (on the Morphometer Sticks). The detected contour is marked by the red crosses (Marks). Data are saved in a text-file with extension MKS and can be accessed from other programs as well. Remember to calibrate the pixel to mm relation by using the calibration marks in the picture together with the facilities in the window.

Fish Shape Fit Window



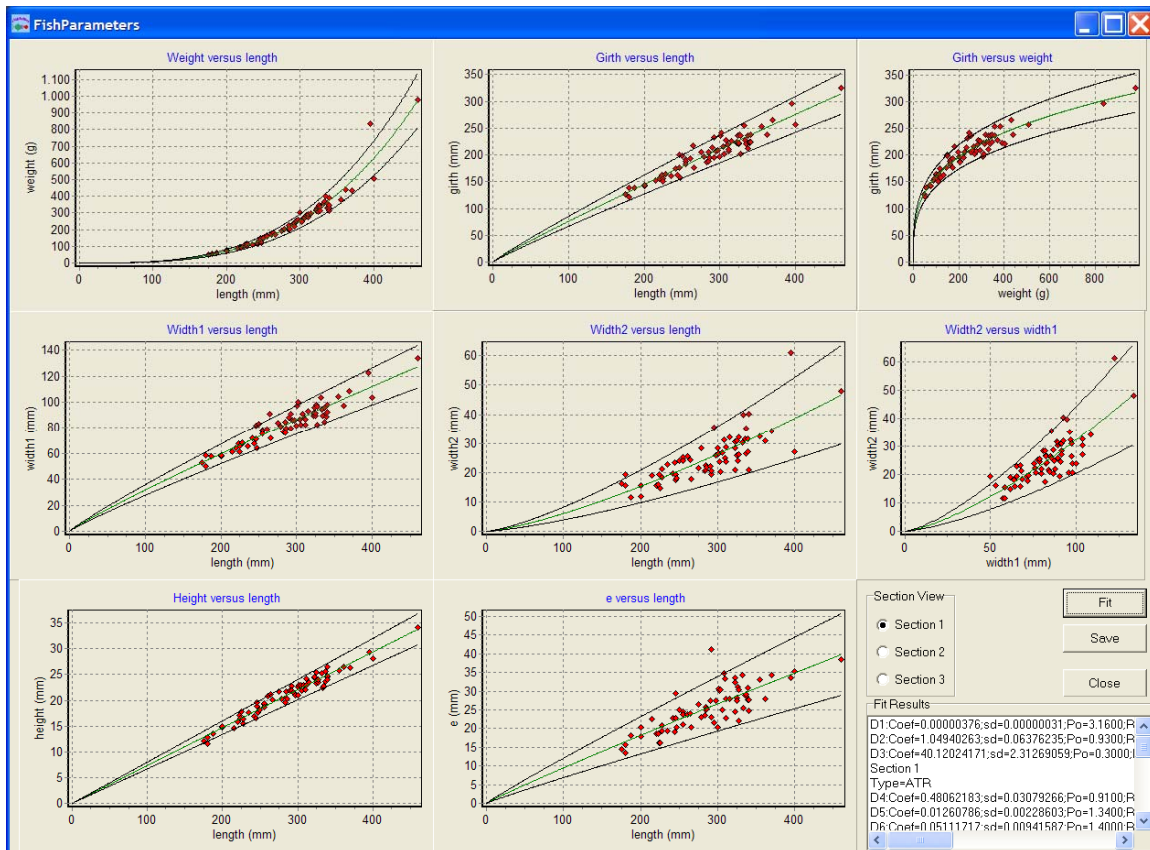
Access: from **Fish List Windows** by activating button **Shape Fit**.

Use the **Fish Shape Window** to fit basic geometrical shapes to the mks-files defining the fish cross section shape and size.

Five cross section shape types are implemented: ELL (Ellipse), HEL (half ellipse), TRI (Triangle), TRA (Symmetrical Trapezoid), ATR (Asymmetrical Trapezoid).

The main result from the fit is shown in the **Fit Result Panel**. In the shown example, an ellipsoid is fitted to the points. Cross section height (h) is found to be 61.69 mm, width (w) is 42.83 mm and circumference (g) is found to be 165.51mm. The mean difference between the points and the fitted ellipsoid is 0.60 mm while the maximum difference is found to be 1.88 mm. The fitting procedure is based on a least square technique.

Fish Parameters Window

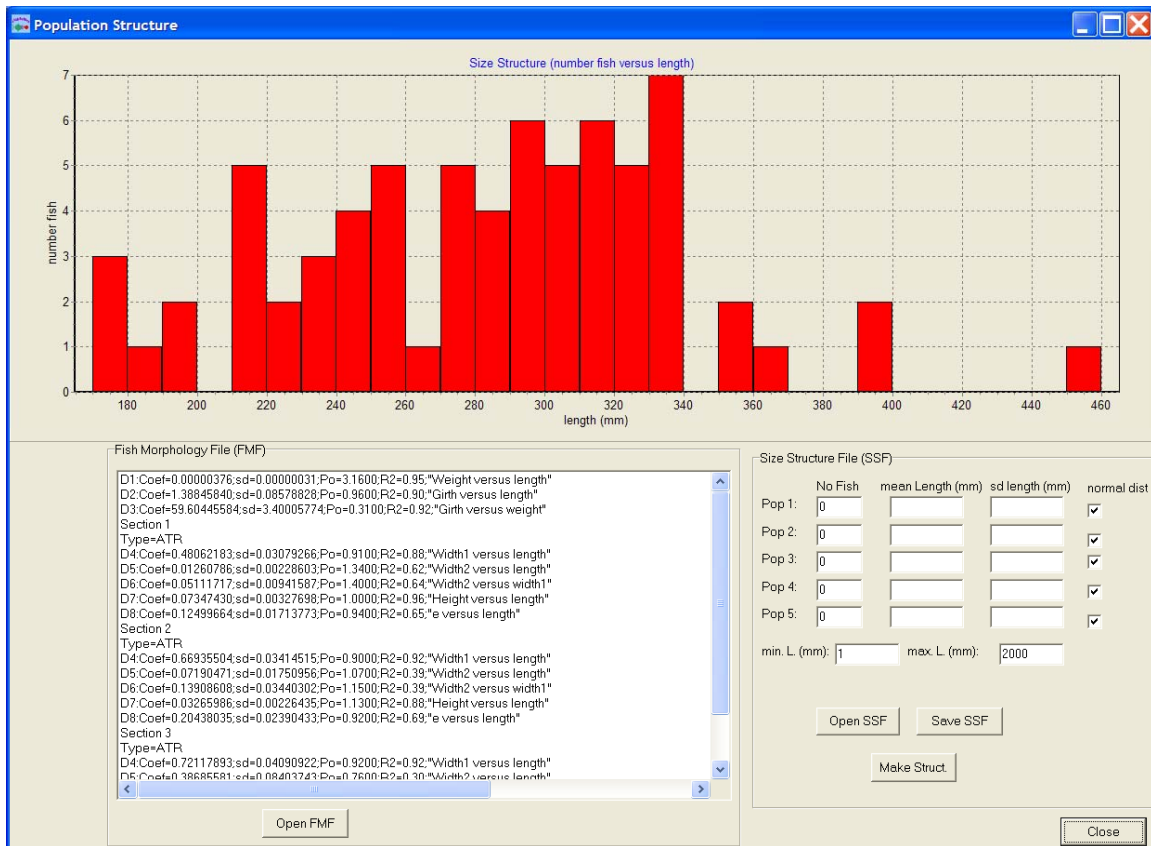


Access: from **Fish List Window** by activating button **Fish Par**.

Use the **Fish Parameters Window** to estimate the mean and standard deviation of the parameters describing the relations between fish length, fish weight and cross section shape measures.

The example shows plots of the parameters, when asymmetrical trapezoids are fitted to the cross section measures of Cs1 (cross section immediately behind the head) for a batch of plaice. Use the button **Fit** to estimate the relationships, which are shown in the **Fit Results** panel. The plots show the mean relationships (center line) and mean ± 2 times standard deviation.

Fish Size Structure Window



Access: from **Fish List Window** by activating button **Fish Struct.**

The window is used to check size structure of fish examined in the lab and to create a virtual population of fish.

Penetration Model Window

Escapement model : C:\Documents and Settings\bhe\Desktop\paper Plaice\Designguide\Escapement model\plaice fi...

Fish Cross Section 1
 Section used=Yes
 Escapement Model=Stiff
 Scale Down=0.0
 width cut of, hc=70
 Scale width=0.6
 Scale Height=1.0

Fish Cross Section 2
 Section used=No
 Escapement Model=Stiff
 Scale Down=0.0
 width cut of, hc=0.0
 Scale width=1.0
 Scale Height=1.0

Fish Cross Section 3
 Section used=Yes
 Escapement Model=Stiff
 Scale Down=0.0
 width cut of, hc=22
 Scale width=1.0
 Scale Height=0.75

Fish Cross Section 1
☒ used
 Escapement Model
☒ Stiff
☐ Soft
 Scale Down (%) Scale width, height
 Width Cut of (% of height)

Fish Cross Section 2
☐ used
 Escapement Model
☒ Stiff
☐ Soft
 Scale Down (%) Scale width, height
 Width Cut of (% of height)

Fish Cross Section 3
☒ used
 Escapement Model
☒ Stiff
☐ Soft
 Scale Down (%) Scale width, height
 Width Cut of (% of height)

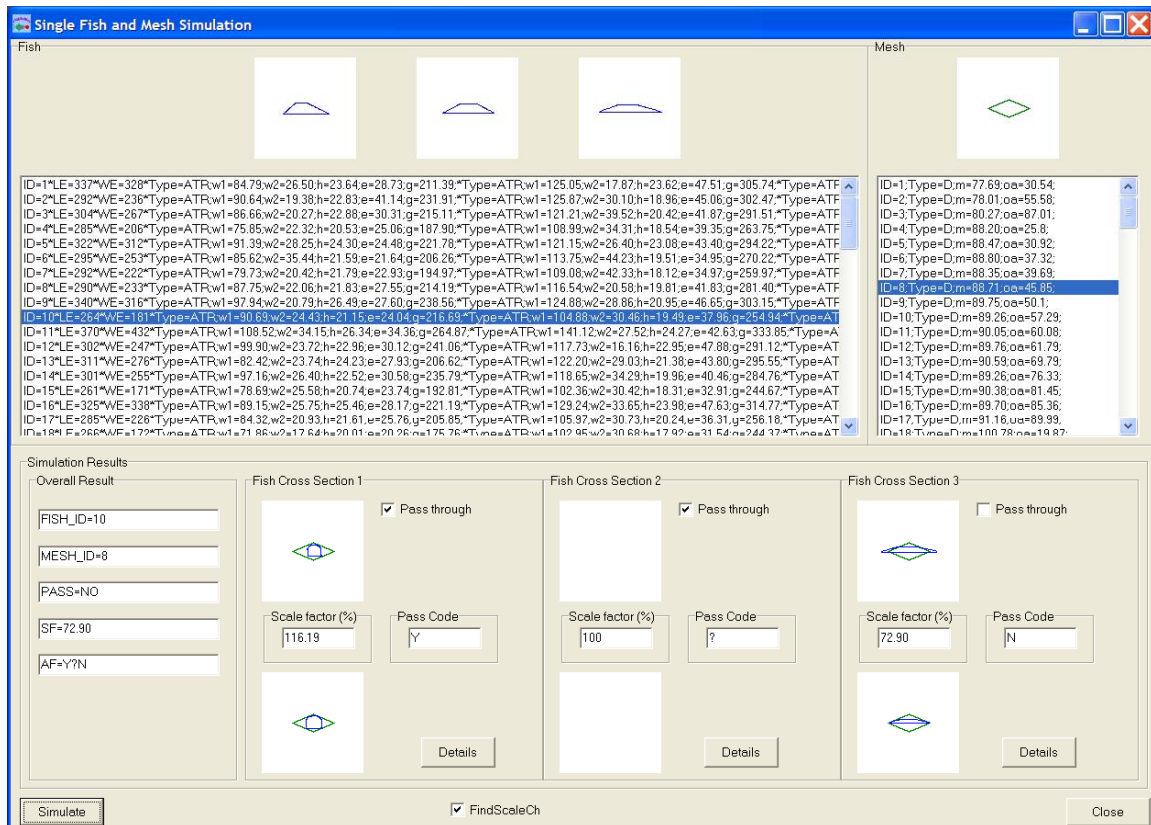
CS1_Stiff;SD1=0.0;Cut1=70;SW1=0.6;SH1=1.0;
 CS2_NONE;
 CS3_Stiff;SD3=0.0;Cut3=22;SW3=1.0;SH3=0.75;

Open File Save File Update Close

Access: from **Main Window** by activating button **Escape Model**.

The window is used to enter the penetration model that is used in the subsequent simulations. The model is saved as a text file with the extension EMF.

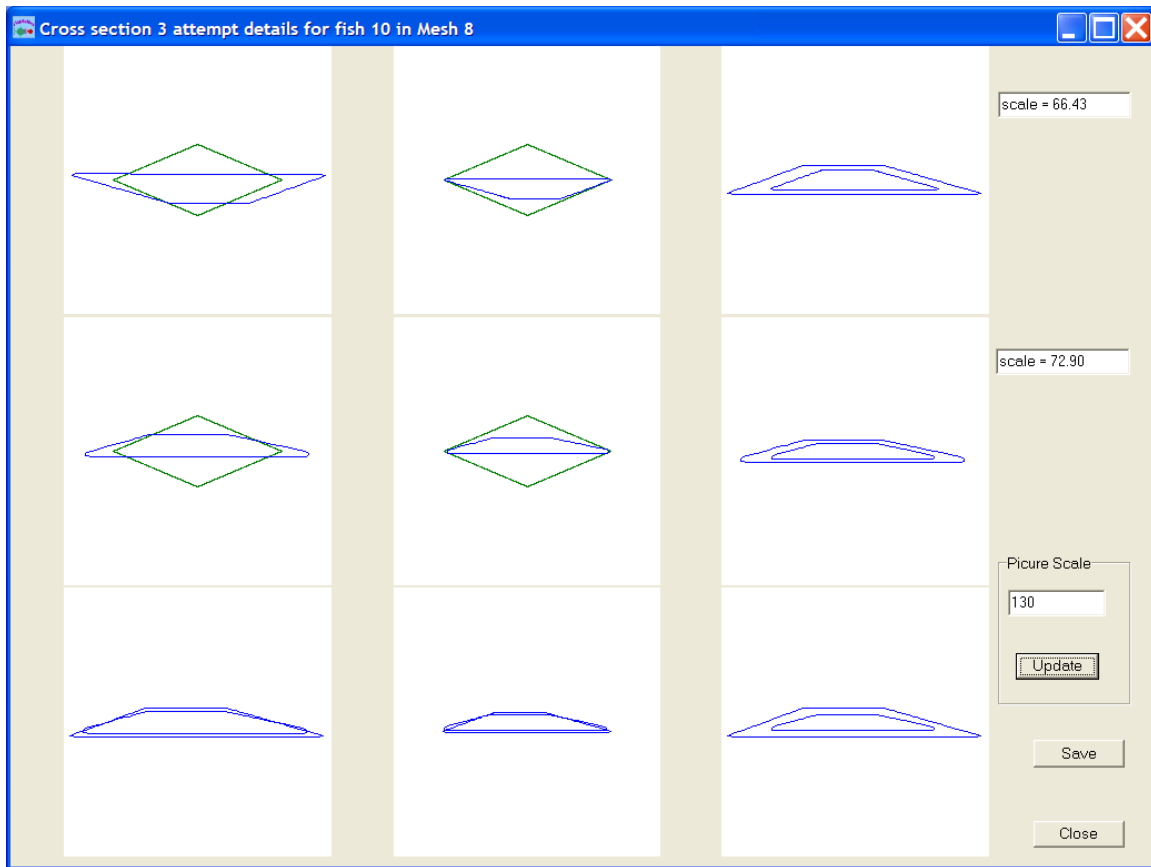
Single Simulation Window



Access: from **Main Window** by activating button **Single Sim**. Can also be accessed through: **Multiple Simulation Window**, **Simulation Result Matrix Window**, **Compare Simulation and Experimental Penetration Result Window**, **Compare Result Matrix Window**.

The window is used to test penetration of one fish in one mesh by use of the penetration model shown in the **penetration model window**.

Simulation Detail Window



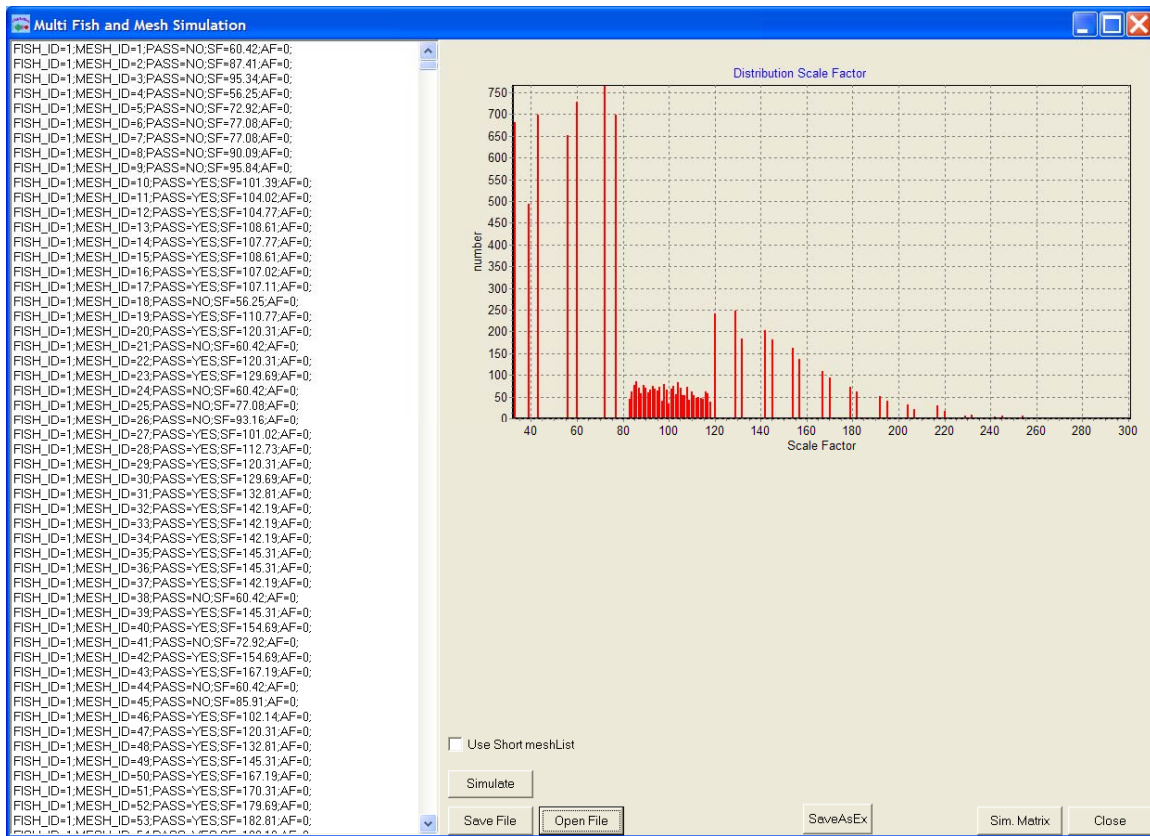
Access: from **Single Simulation Window** by activating button **Details**.

The window illustrates the scaling needed to:

- fit the original cross section to the mesh (upper row)
- fit the cross section compressed according to the penetration model, to the mesh (middle row)

Bottom row illustrates the effect on the cross section of compression, cutting and downscaling.

Multiple Simulation Window



Access: from **Main Window** by activating button **Multi Sim**.

The window is used to test all fish in all meshes using the penetration model shown in the **penetration model window**. Results can be saved as a text file with the extension MSF.

Simulation Results Matrix Window

[illegible]

Access: from **Multiple Simulation Window** by activating button **Sim Matrix**. The window shows the simulated penetration results obtained in the **Multiple Simulation Window**. Y indicates success and N indicates failure. Scroll by clicking the **Mesh Gr** or **Fish Gr** buttons.

Experimental Results Penetration Window

Experimental Results For File: C:\Documents and Settings\bhe\Desktop\paper 1 cod\cod_cleaned.EXR

FISH_ID:1.MESH_ID=1.PASS=NO
 FISH_ID=1.MESH_ID=2.PASS=NO
 FISH_ID=1.MESH_ID=3.PASS=NO
 FISH_ID=1.MESH_ID=4.PASS=NO
 FISH_ID=1.MESH_ID=5.PASS=NO
 FISH_ID=1.MESH_ID=6.PASS=NO
 FISH_ID=1.MESH_ID=7.PASS=NO
 FISH_ID=1.MESH_ID=8.PASS=NO
 FISH_ID=1.MESH_ID=9.PASS=NO
 FISH_ID=1.MESH_ID=10.PASS=NO
 FISH_ID=1.MESH_ID=11.PASS=NO
 FISH_ID=1.MESH_ID=12.PASS=NO
 FISH_ID=1.MESH_ID=13.PASS=YES
 FISH_ID=1.MESH_ID=14.PASS=YES
 FISH_ID=1.MESH_ID=15.PASS=YES
 FISH_ID=1.MESH_ID=16.PASS=YES
 FISH_ID=1.MESH_ID=17.PASS=YES
 FISH_ID=1.MESH_ID=18.PASS=NO
 FISH_ID=1.MESH_ID=19.PASS=YES
 FISH_ID=1.MESH_ID=20.PASS=YES
 FISH_ID=1.MESH_ID=21.PASS=NO
 FISH_ID=1.MESH_ID=22.PASS=YES
 FISH_ID=1.MESH_ID=23.PASS=YES
 FISH_ID=1.MESH_ID=24.PASS=NO
 FISH_ID=1.MESH_ID=25.PASS=NO
 FISH_ID=1.MESH_ID=26.PASS=NO
 FISH_ID=1.MESH_ID=27.PASS=NO
 FISH_ID=1.MESH_ID=28.PASS=YES
 FISH_ID=1.MESH_ID=29.PASS=YES
 FISH_ID=1.MESH_ID=30.PASS=YES
 FISH_ID=1.MESH_ID=31.PASS=YES
 FISH_ID=1.MESH_ID=32.PASS=YES
 FISH_ID=1.MESH_ID=33.PASS=YES
 FISH_ID=1.MESH_ID=34.PASS=YES
 FISH_ID=1.MESH_ID=35.PASS=YES
 FISH_ID=1.MESH_ID=36.PASS=YES
 FISH_ID=1.MESH_ID=37.PASS=YES
 FISH_ID=1.MESH_ID=38.PASS=NO
 FISH_ID=1.MESH_ID=39.PASS=YES
 FISH_ID=1.MESH_ID=40.PASS=YES
 FISH_ID=1.MESH_ID=41.PASS=NO
 FISH_ID=1.MESH_ID=42.PASS=YES
 FISH_ID=1.MESH_ID=43.PASS=YES
 FISH_ID=1.MESH_ID=44.PASS=NO
 FISH_ID=1.MESH_ID=45.PASS=NO
 FISH_ID=1.MESH_ID=46.PASS=NO
 FISH_ID=1.MESH_ID=47.PASS=YES
 FISH_ID=1.MESH_ID=48.PASS=YES
 FISH_ID=1.MESH_ID=49.PASS=YES
 FISH_ID=1.MESH_ID=50.PASS=YES
 FISH_ID=1.MESH_ID=51.PASS=YES
 FISH_ID=1.MESH_ID=52.PASS=YES
 FISH_ID=1.MESH_ID=53.PASS=YES

FISHID: 1 MESHID: 1

PASS: ☐ YES ☒ NO ☐ ?

Set YES Set NO Set ?

Previous Next

Clear Add Fish Delete Fish

SAVE DATA FOR SELECTED MESH AS SIM.F:

Selected Mesh ID: 1

Make Single Make All

Open Save Res. Matrix Close

Access: from **Main Window** by activating button **Exp. Res.**

The window is used to simultaneously enter experimental results. If a fish is able to pass through a given mesh, the **SetYes** button is clicked. If it doesn't pass through the mesh click the **SetNo** button. In cases where the result is assessed to be unreliable it should be entered as a question mark. In the subsequent analyses, question marks will be treated as missing values. The results can be saved as a text file with the extension EXR.

Experimental Results Matrix Window

Simulation Results Matrix

MESH ID

Mesh Gr 1

Mesh Gr 2

Mesh Gr 3

FISH ID

Fish Gr 1

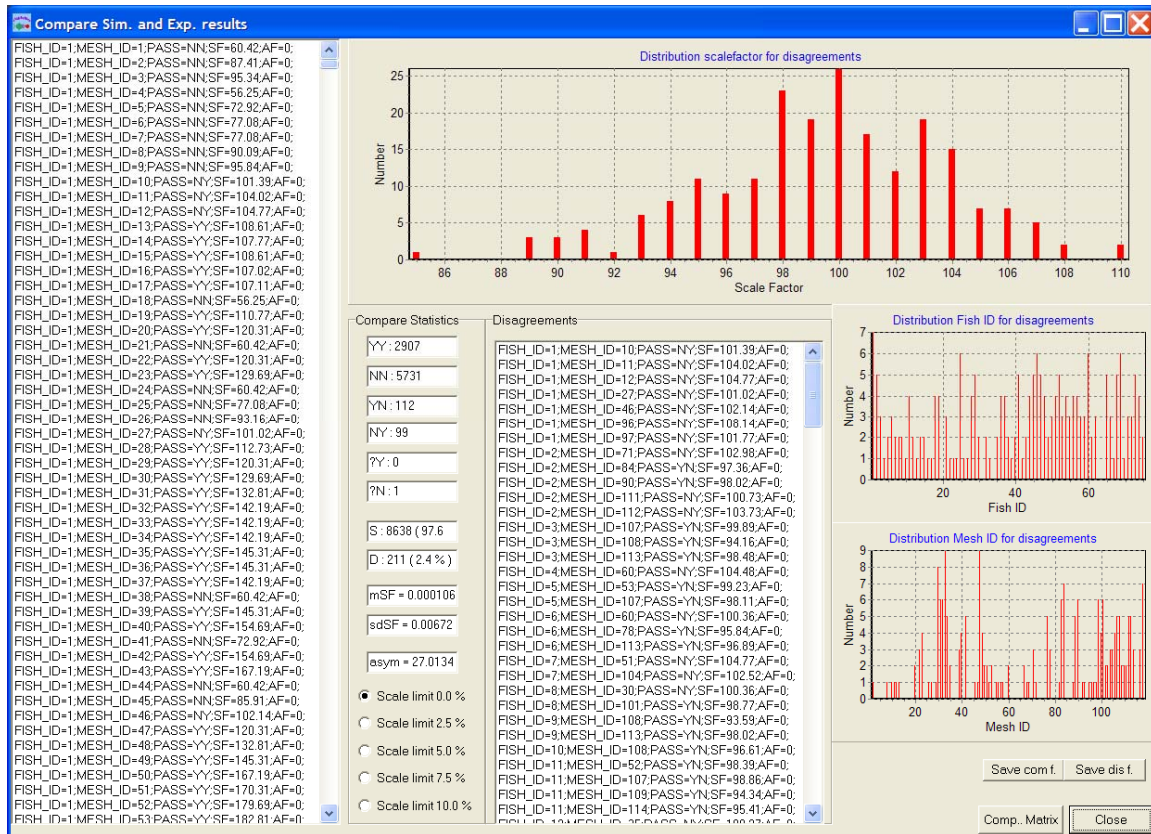
Fish Gr 2

Fish Gr 3

Close

Access: from **Experimental Result Window** by activating button **Res. Matrix**.
 The window shows the experimental results. Y indicates success and N indicates failure.
 Scroll by clicking the **MeshGr** or **FishGr** buttons.

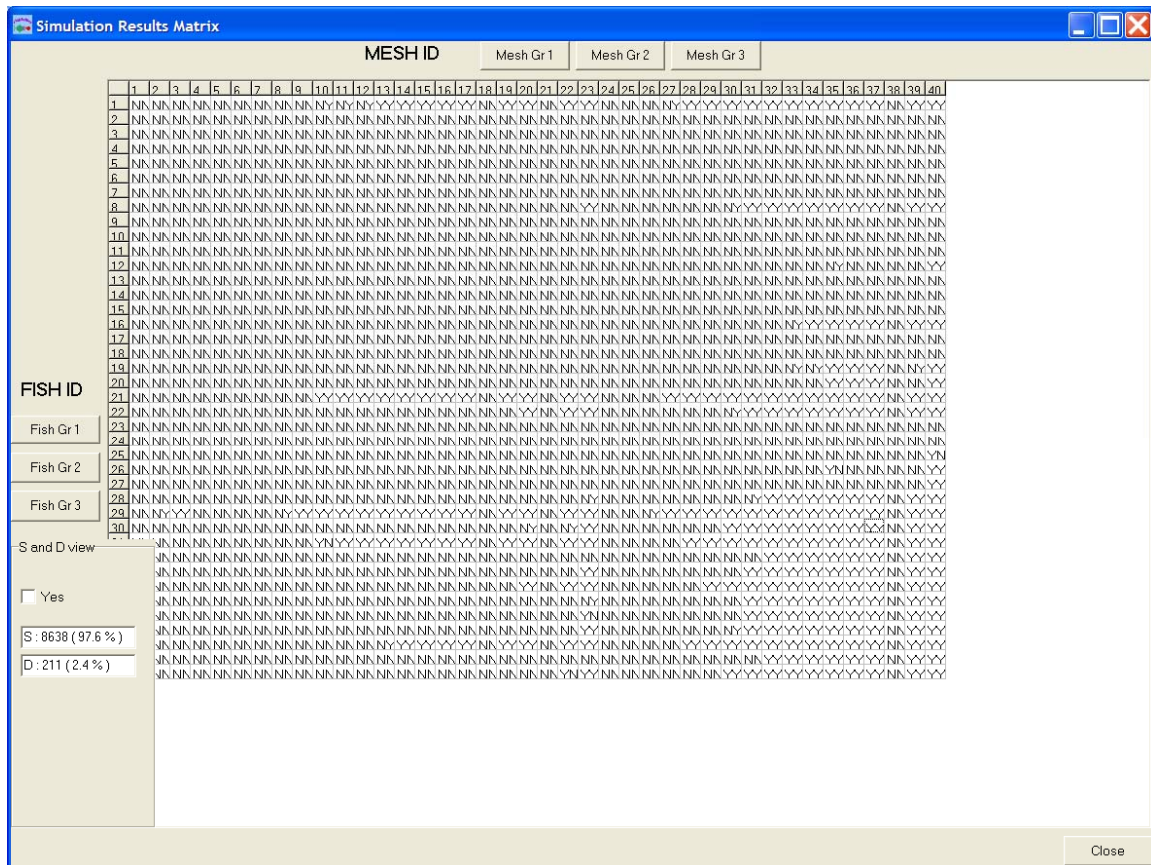
Compare Simulation and Experimental Penetration Results Window



Access: from **Main Window** by activating button **Compare**.

In this window, the simulated results are held against the experimental. It gives an overview of agreements and disagreements and is used to evaluate the tested penetration model. The complete comparison file is shown in the left most panel and can be saved as a text file with the extension CSE. In the **compare statistics panel** the number of agreements (YY and NN) and disagreements (YN, NY, ?Y and ?N) are given. The first letter is the experimental result and the second letter is the simulated result. The agreements are summed up and shown as the S-value while the summed up disagreement is given as the D value. To limit the number of shown disagreements in the **Disagreement panel** check a scale limit different from 0%. The higher the scale limit, the bigger the disagreement. This feature is an important tool for data validation. The disagreements shown in the **Disagreement panel** can be saved as a text file with the extension DIS.

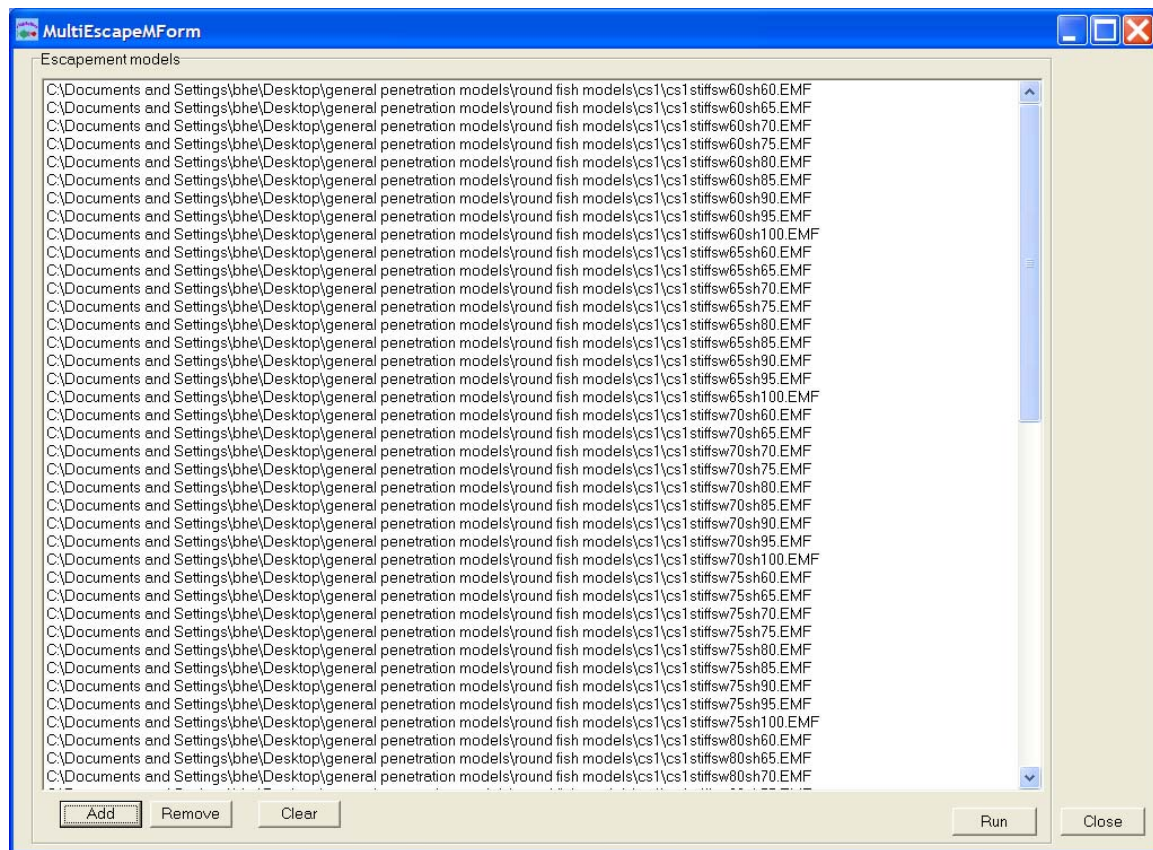
Compare Results Matrix Window



Access: from **Compare Simulation and Experimental penetration Results Window**
by activating button **Comp. Matrix**.

Matrix view of the comparison of simulated and experimental results. First letter in each box is the experimental result, second letter is the simulated result. Scroll by clicking the **MeshGr** or **FishGr** buttons.

Multiple Penetration Models Simulation Window

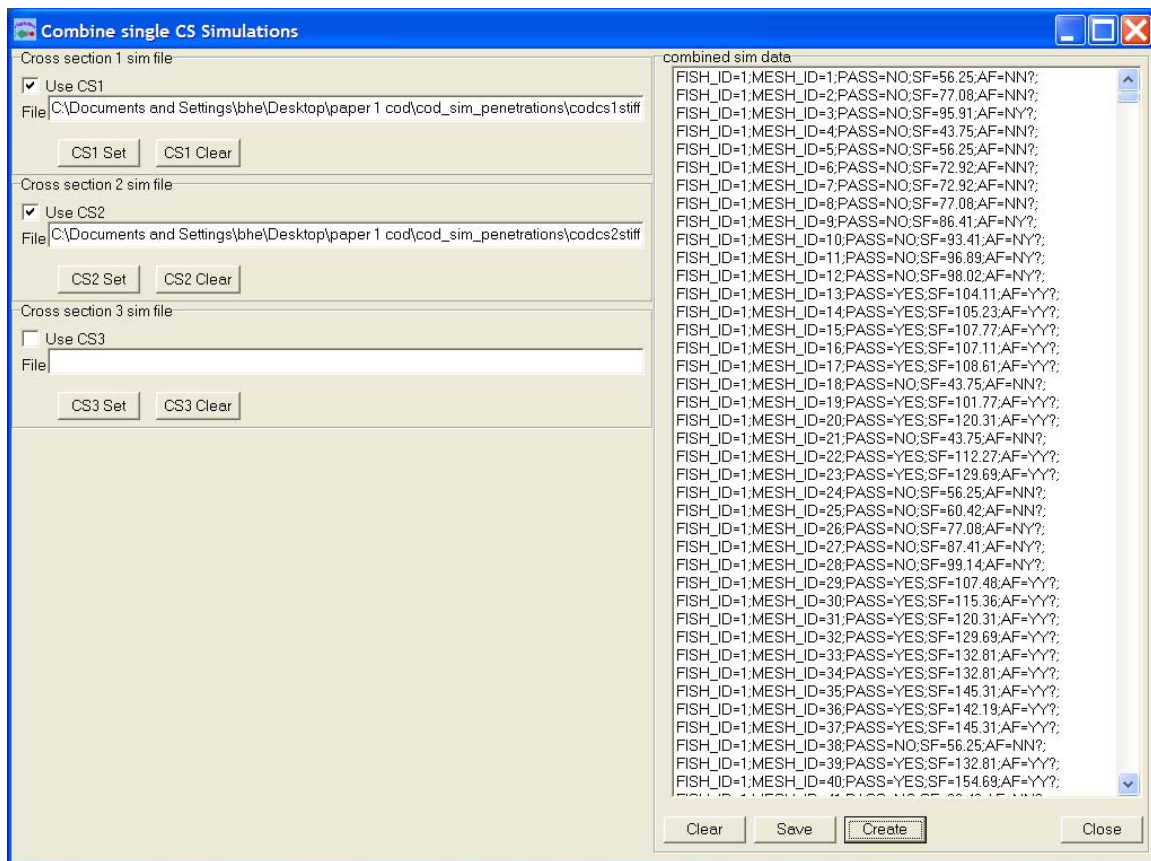


Access: from **Main Window** by activating button **M. Escape M.**

In order to identify the penetration model that can be used to simulate penetration results most accurately it is most efficient to run the different cross sections separately. This window allows the user to run a series of different compressions and cuttings.

The output is a list of all the tested penetration models and their DA values (degree of agreement).

Combine Cross section Simulations Window

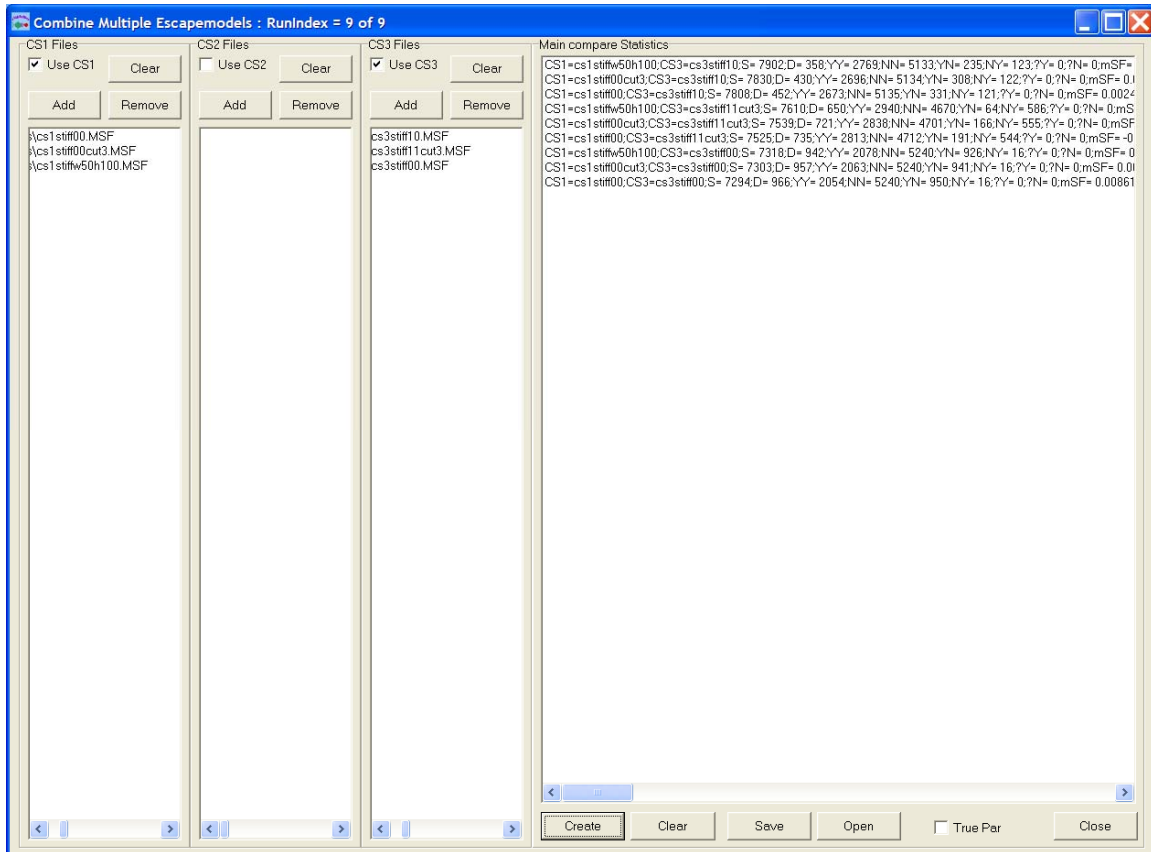


Access: from **Main Window** by activating button **Combine Sim**.

Simulated results based on the different cross sections can be combined in this window.

This is relevant if the user only needs to compare one or few penetration models for each cross section. Else see **Compare Multiple Combinations Models Window**.

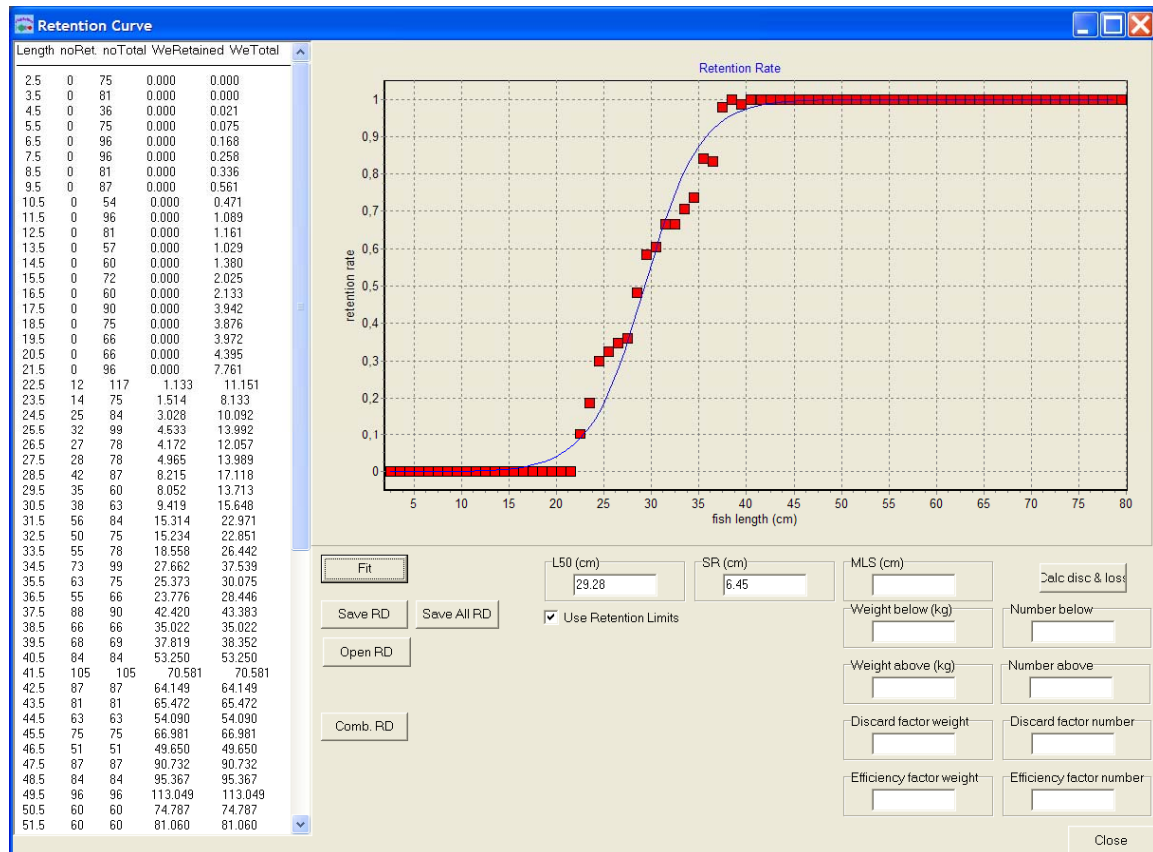
Compare Multiple Combinations Models Window



Access: from **Main Window** by activating button **Combine Mul.**

This window allows combination of series of different penetration models for all cross sections. The output lists all combination with a value of disagreement and can be saved as a text file with the extension MCF.

Retention Estimation Window



Access: from **Main Window** by activating button **Retention C**.

A sigmoid selection curve is fitted to data simulated by use of a virtual population, the mesh under investigation and the penetration model found to predict penetration most accurately. Click the **SaveAllRD** for use when creating the design guide in the **Design Guide Window**.

Combine Retention Data Window

Combine Retention Data

RDFiles and Weight factor

RD files

- ings\bhe\Desktop\paper 1 cod\sim Galbraith (m109)\cod_m109OA25.RDF
- ings\bhe\Desktop\paper 1 cod\sim Galbraith (m109)\cod_m109OA35.RDF
- ings\bhe\Desktop\paper 1 cod\sim Galbraith (m109)\cod_m109OA50.RDF

Weight Factor

1.0
1.0
1.0

Combined retention data

Length	noRet	noTotal	WeRetained	WeTotal
2.5	0	75	0.000	0.000
3.5	0	81	0.000	0.000
4.5	0	36	0.000	0.021
5.5	0	75	0.000	0.075
6.5	0	96	0.000	0.168
7.5	0	96	0.000	0.258
8.5	0	81	0.000	0.336
9.5	0	87	0.000	0.561
10.5	0	54	0.000	0.471
11.5	0	96	0.000	1.089
12.5	0	81	0.000	1.161
13.5	0	57	0.000	1.029
14.5	0	60	0.000	1.380
15.5	0	72	0.000	2.025
16.5	0	60	0.000	2.133
17.5	0	90	0.000	3.942
18.5	0	75	0.000	3.876
19.5	0	66	0.000	3.972
20.5	0	66	0.000	4.395
21.5	0	96	0.000	7.761
22.5	12	117	1.133	11.151
23.5	14	75	1.514	8.133
24.5	25	84	3.028	10.092
25.5	32	99	4.533	13.992
26.5	27	78	4.172	12.057
27.5	28	78	4.965	13.989
28.5	42	87	8.215	17.118
29.5	35	60	8.052	13.713
30.5	38	63	9.419	15.648
31.5	56	84	15.314	22.971
32.5	50	75	15.234	22.851
33.5	55	78	18.558	26.442
34.5	73	99	27.662	37.539
35.5	63	75	25.373	30.075
36.5	55	66	23.776	28.446
37.5	88	90	42.420	43.383
38.5	66	66	35.0??	35.0??

0.0

Update

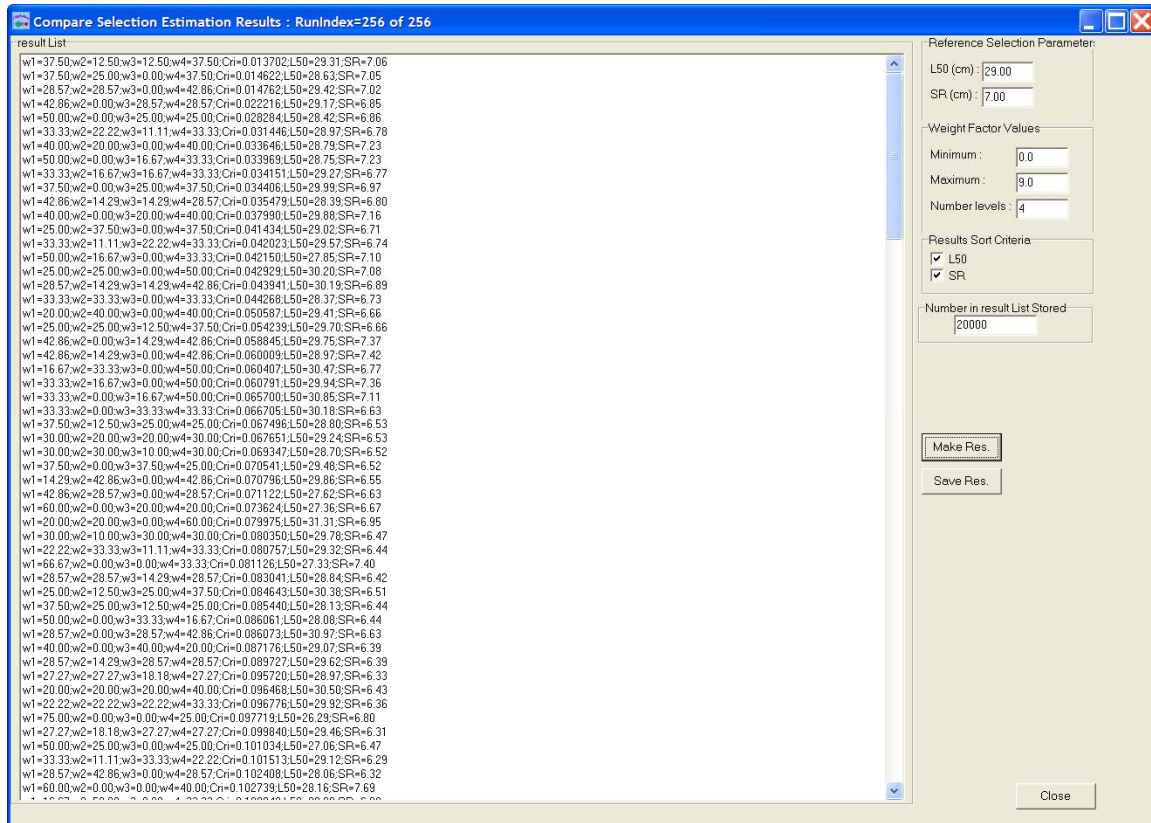
Clear Update Transfer

Close

Access: from **Retention Estimation Window** by activating button **Comb. RD**.
 Selection parameters for series of meshes present in the netting panel under investigation (e.g. 90 mm diamond meshes with different opening angles) is combined in order to obtain selection parameters for the entire codend. It is possible to weight the selection parameters differently. A build in feature automatically tests different combinations of weighting – click the **Com Sel Est** button!

The retention data can be fitted to a selection curve by clicking the **Transfer** button and return to the **Retention Estimation Window**.

Compare Selection Estimates



Access: from **Combine Retention Data Window** by activating button **Com. Sel. Est.**

In cases where the weighting of different mesh configurations e.g. opening angles in a 90 mm diamond mesh codend is unknown, it may be useful to test different combinations of weightings against selection parameters obtained in field experiments.

It uses the meshes shown in the **Combine Retention Data Window**. Insert L50 and SR in the upper right corner and define the levels of weighting that is likely to occur.

Minimum limit should be 0 which opens for the possibility that the specific mesh is without importance for the grand result. The computing is time consuming and the number of levels should be kept low.

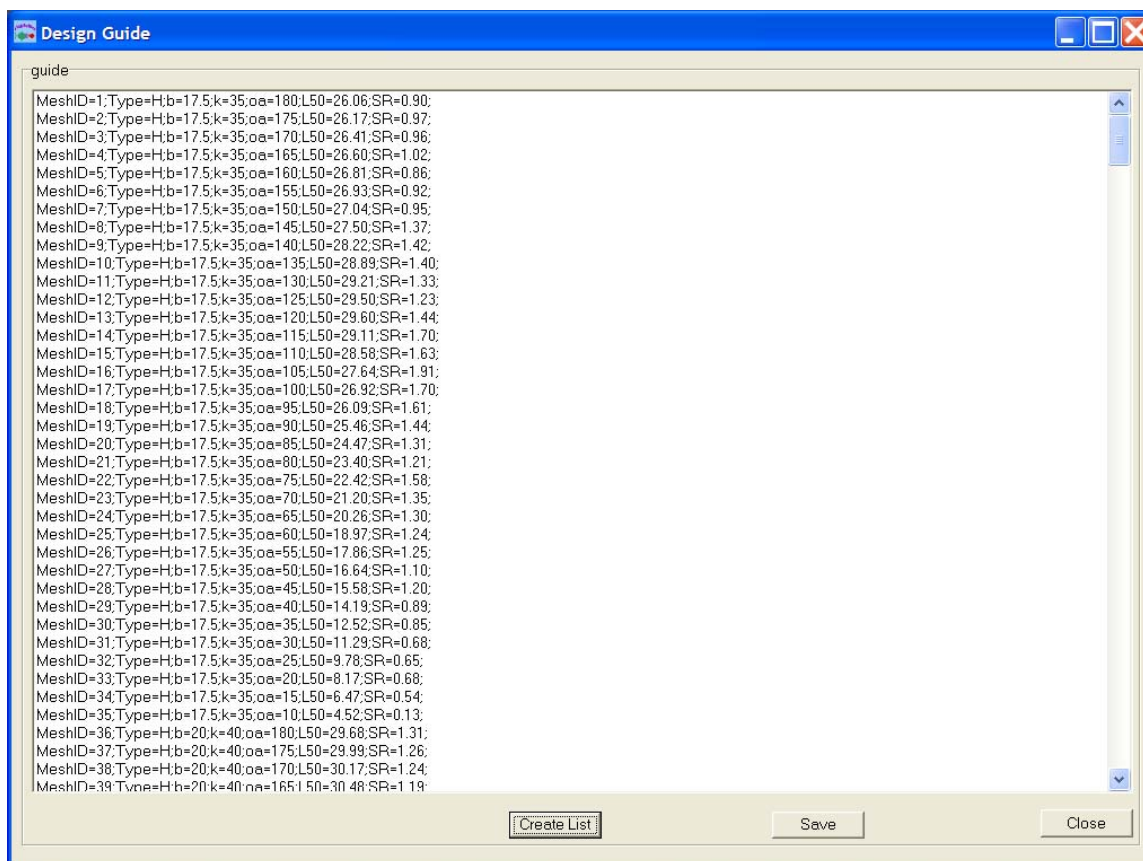
The generated list is shown in the panel and is prioritized showing the combination of weighting that results in parameter estimates closests to the ones given.

The prioritization is based on the *Cri*-value:

$$Cri = \sqrt{\left(\frac{simL_{50} - refL_{50}}{refL_{50}} \right)^2 + \left(\frac{simSR - refSR}{refSR} \right)^2}$$

where simL50 and refL50 are simulated and reference L50 respectively. The same syntax is used for SR. For a perfect match with the experimental results (simL50 = refL50 and simSR = refSR) Cri will be zero.

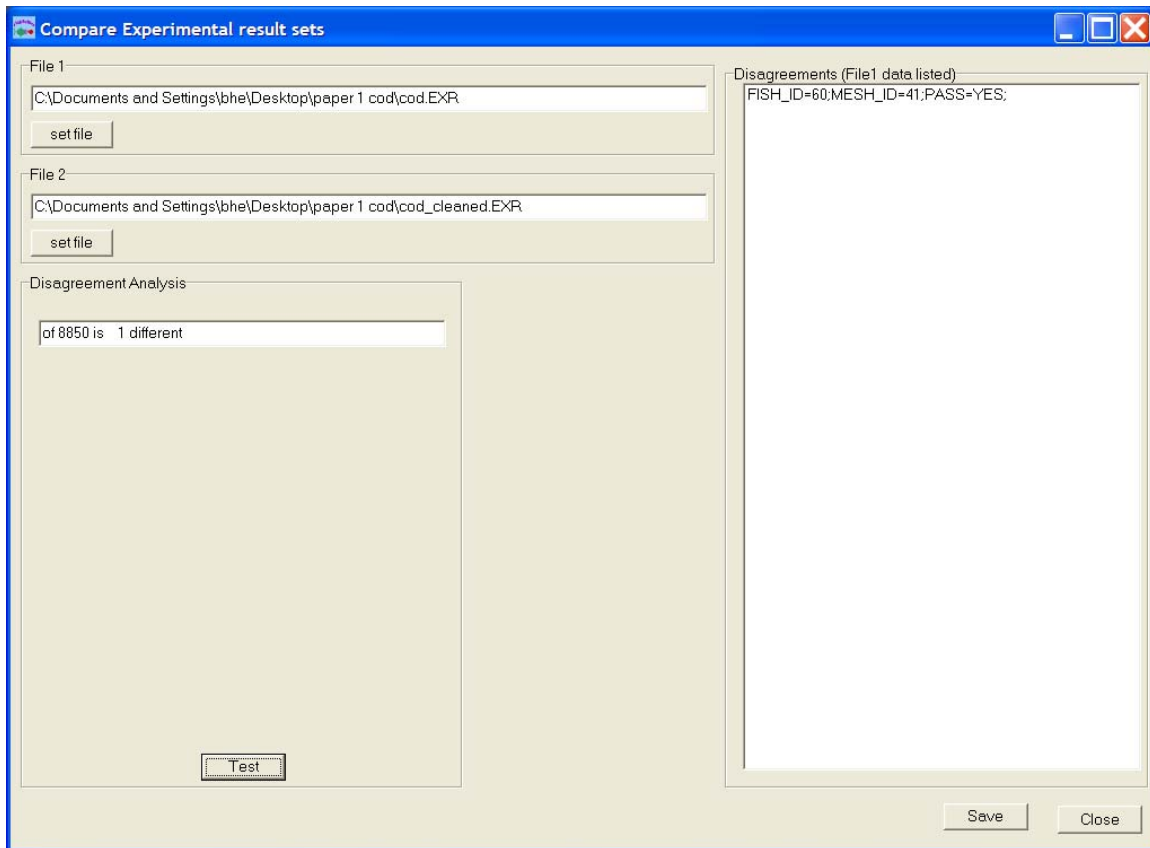
Design Guide Window



Access: from **Main Window** by activating button **D. Guide**.

The features build in in this window, creates the design guide. The list of L50's and SR's can be plotted as an isoplot. When clicking the **Create List** button, the program prompts for one of the retention data files created in the **Retention Estimation Window**.

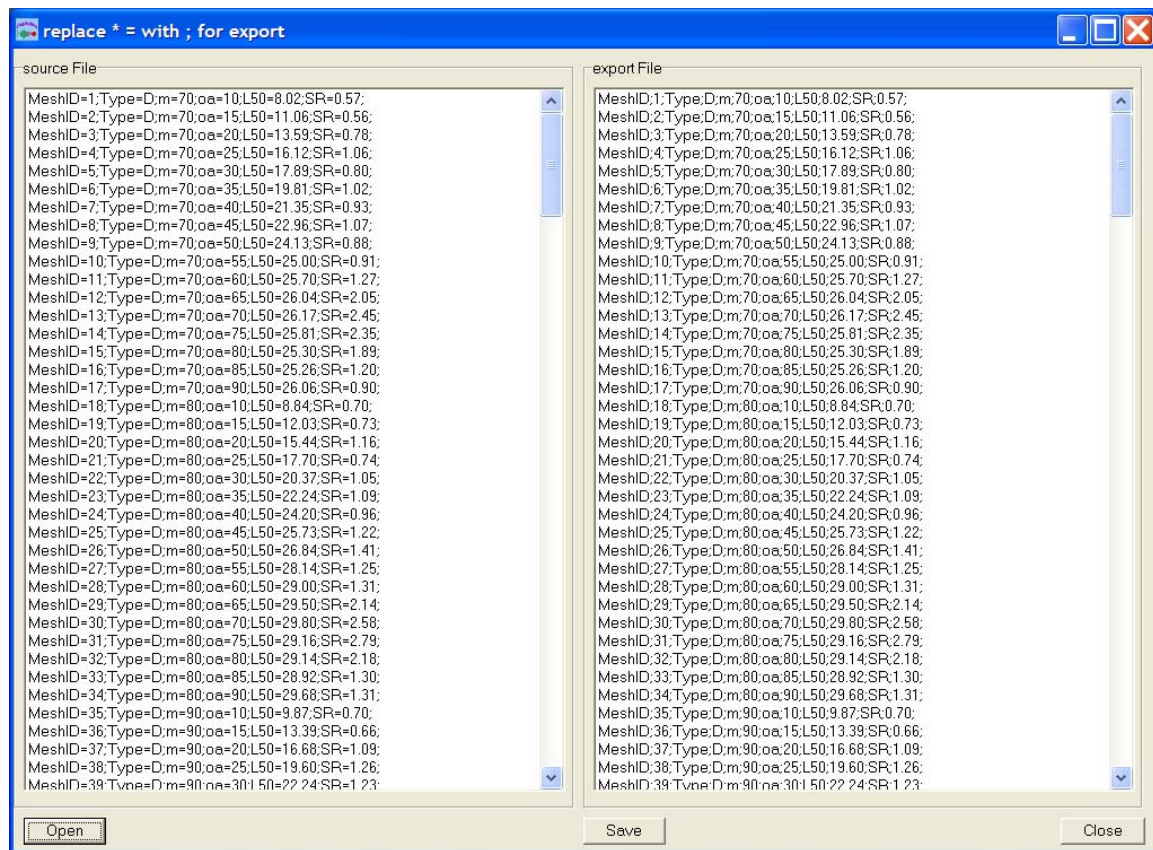
Compare Experimental Penetration Results Window



Access: from **Main Window** by activating button **Comp. Exp.**

In order to validate the penetration experiment a number of fish should repeatedly be tested. To test whether a change in results happen e.g. as a consequence of degradation of the fish, the two files listing the experimental results are held against each other.

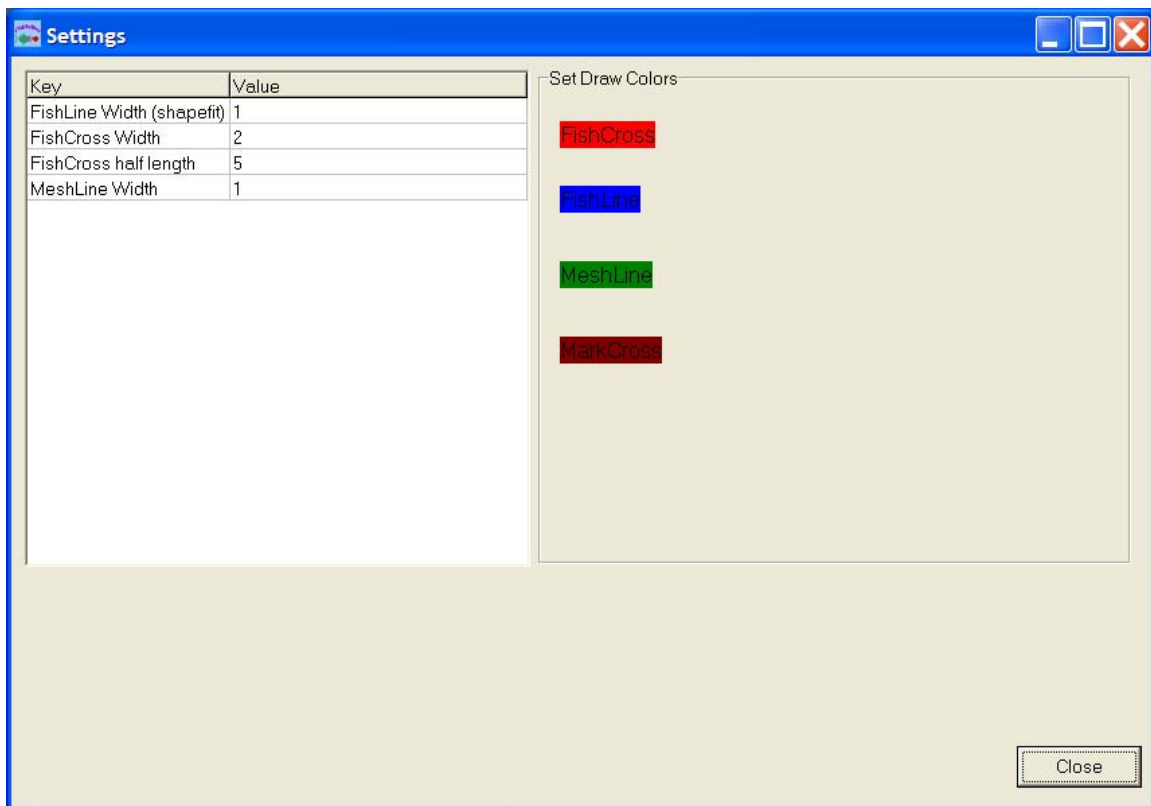
Export Data Window



Access: from **Main Window** by activating button **Export**.

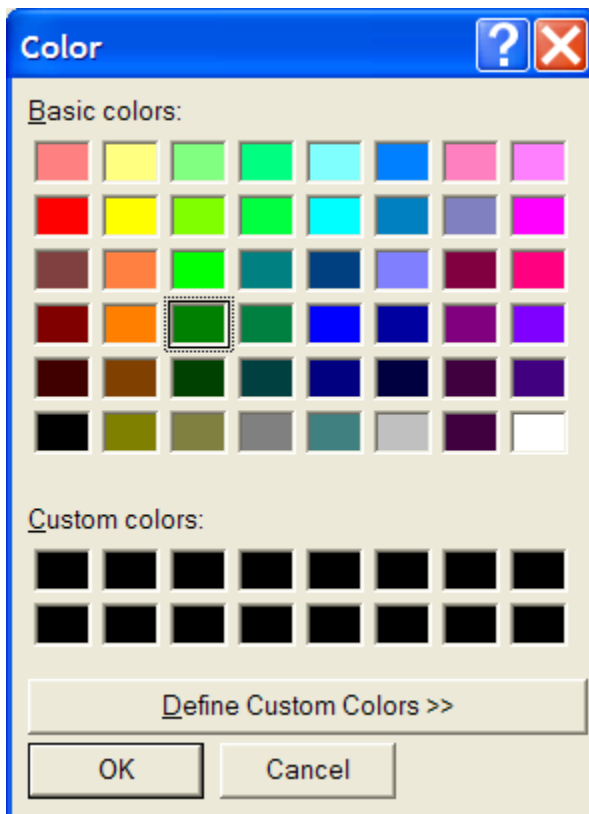
This feature is used to change the syntax used in all FISHSELECT files into a format which is easily read in e.g. Microsoft Excel.

Settings Window



Access: from **Main Window** by activating button **Settings**.
Use this window to change colors in marks and lines.

Colour Dialog



Access: from **Settings Window** by activating one of the **colour buttons**.